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IMPROVED DEWATERING APPARATUS AND METHOD FOR WATER TREATMENT AND ENERGY GENERATION

Introduction

The present invention relates to a pneumatic dewatering and drying apparatus for wet product comprising a cyclone chamber connected to a fan having a housing mounting blades, each blade causing individual flow vortices to be formed downstream of the fan which in turn combine to form cyclonic flow of the fluid within the cyclone chamber in which the cyclone chamber comprises at least one of a vortex flow forming section feeding a vortex flow shedding section, the vortex flow forming section comprising vortex flow forming means to cause reformation of vortex flow within the cyclone chamber on dissipation of the vortex flow along the cyclone chamber remote from the fan and a product inlet hopper downstream of the fan. It further relates to a method of dewatering and drying wet product. It is particularly directed to use with and modification of the apparatus of a co-pending PCT Patent Application No. PCT/IE03/00062 (Solid Solutions Limited) the inventor of which is the inventor of the present application. All the disclosure of this patent application is incorporated herein by direct reference. Thus, the discussion of the whole dewatering apparatus and the theory thereof is not contained herein.

Essentially, the apparatus of the previous application allowed the drying through considerable dissociation and boiling in various parts of the apparatus under a vacuum supported by cavitation devices included in the apparatus. There were frusto-conical cones and the generation of centripetal vortices by the use of various vortex forming devices.

Ideally, the more vacuum that can be created and the more ionisation, the better.

Further, the invention is directed towards improving the apparatus, as described in this previous pending patent application, and also to finding other uses for the apparatus when carrying out the process of dewatering and drying.

The invention is particularly directed towards the treatment of relatively difficult waste

products such as those that are extremely acidic or alkaline. It is also directed towards finding other useful commercial uses for the apparatus.

Statements of Invention

According to the invention, there is provided a pneumatic de-watering and drying apparatus for wet product comprising a cyclone chamber connected to a fan having a housing mounting blades, each blade causing individual flow vortices to be formed downstream of the fan which in turn combine to form cyclonic flow of the fluid within the cyclone chamber in which the cyclone chamber comprises at least one of a vortex flow forming section feeding a vortex flow shedding section, the vortex flow forming section comprising vortex flow forming means to cause reformation of vortex flow within the cyclone chamber on dissipation of the vortex flow along the cyclone chamber remote from the fan and a product inlet hopper downstream of the fan characterised in that ionisation means are provided to cause further ionisation of the fluid as it progresses through the cyclone chamber. It has been found that the use of ionisation means greatly improves the operation of the pneumatic dewatering and drying apparatus.

In one embodiment of the invention, the ionisation means comprises a plasma generator having an enclosed plasma chamber, at least part of which is mounted in close proximity to portions of the cyclone chamber and in which the plasma chamber and those portions of the cyclone chamber adjacent the plasma chamber are of a non-ferromagnetic material. The plasma chamber may be in the form of a hollow torroidal tube surrounding a vortex flow forming section and may include a plurality of torroidal tubes surrounding the vortex flow forming section. The advantage of the plasma chamber has been quite surprising in that the operation of the apparatus has been greatly improved by its use.

Ideally, there are a plurality of vortex flow forming sections and each vortex flow forming section is surrounded by a plasma chamber.

In another embodiment of the invention, the plasma chamber comprises an enclosed spirally wound tube around the cyclone chamber from adjacent the product inlet

hopper to adjacent the fan and then returned remote from the cyclone chamber.

Ideally, the plasma chamber is filled with an inert gas carrying a metallic salt.

In a still further embodiment of the invention, the vortex flow forming means comprises a vortex flow forming device substantially centrally mounted within the vortex flow forming section, the vortex flow forming device further comprising an anode and the portion of the cyclone chamber forming the vortex flow forming section comprising a cathode and a DC power source connected between the anode and the cathode.

In another embodiment, the vortex flow forming means comprises a vortex flow forming device substantially centrally mounted within the vortex flow forming section, the vortex flow forming device further comprising a cathode and the portion of the cyclone chamber forming the vortex flow forming section comprising an anode and a DC power source connected between the anode and the cathode. The advantage of having the anode at the centre is that it gives off free hydrogen, while if the cathode is at the centre, free oxygen is given off. Both of these can be very important for particular operations and specifically lends itself to desalination in pipes in that chlorine can be separated from sodium. The ions generated by the presence of the cathode or anode respectively, are important and it is possible to achieve 0.25 pH in solutions and reversing the poles will produce copious amounts of various forms of materials having pH's of up to 12.

Ideally, the power source includes a controller to reverse the polarity whereby the anode becomes the cathode and the cathode, the anode. This allows one to easily alter the operation, depending on the raw material.

In another embodiment of the invention, each vortex flow forming device comprises a magnet. It has been found that the use of magnets is particularly effective with centripetal and centrifugal flow, particularly with the centrifugal flow on the exterior of the cyclone chamber.

In another embodiment of the invention, the vortex flow forming device is one of:

an ellipsoid body in the shape of an egg;

an ovaloid shaped body;

a body of reducing cross section from its upstream end to its downstream;

any of the above with additional flow forming vanes on its exterior; and

in which the magnet comprises part of the vortex flow forming device with its poles axially aligned with the cyclone chamber.

The combination of the magnet in close proximity to the vortex forming flow forming device is particularly advantageous and in practice has led to quite surprising results.

In another embodiment of the invention, the vortex flow forming device comprises an electrical generator assembly.

In one embodiment, the downstream portion of the vortex flow forming device comprises a wind turbine connected to an electrical generator housed within the vortex flow forming device.

The wind turbine may comprise blades mounted downstream of the vortex flow forming device.

The vortex flow forming device may be mounted by radially arranged hollow struts forming electrical cable receiving conduits for electrical power take-off.

In another embodiment of the invention, the vortex flow forming device is one of:

an ellipsoid body in the shape of an egg;

an ovaloid shaped body;

a body of reducing cross section from its upstream end to its downstream;

any of the above with additional flow forming vanes on its exterior; and

in which portion of the downstream end of the body is rotatable with respect to the rest of the body and mounts blades for rotation thereof.

One particular arrangement is provided in which a plurality of magnets forming a ring magnet is mounted in the vortex flow forming section in or adjacent the cyclone chamber which is of a non-ferromagnetic material, one of the poles of each magnet being directed towards the vortex flow forming device. The polarity of the magnets may be of opposite polarity to that of adjacent vortex flow forming devices or, as in other embodiments, the polarity of adjacent poles directed into the cyclone chamber forming the one ring magnet are opposite.

Ideally, there is a plurality of ring magnets in the vortex flow forming section.

In another embodiment of the invention, there is provided a pair of vortex flow forming devices mounted in the one vortex flow forming section with a ring magnetic mounted between them, the facing portions of the magnets in the vortex flow forming devices being of different polarity. This has been found to be very effective for achieving dewatering.

In another embodiment of the invention, there is provided a pair of vortex flow forming devices mounted in the one vortex flow forming section with a ring magnet mounted between them, the facing portions of the magnets in the vortex flow forming devices being of the same polarity.

In another embodiment, the ionisation means comprises a source of ozone for introduction into the fluid as it flows through the cyclone chamber.

In a particularly suitable embodiment of the invention, the vortex flow shedding section comprises at least two expansion chambers of greater cross-sectional area than that of the vortex flow forming section upstream of it, the proximal chamber to the vortex flow forming section being of greater cross-sectional area than the distal chamber. It is envisaged that it is possible to provide additional expansion chambers of progressively reducing cross-sectional area from the proximal chamber to the distal chamber.

When successive expansion chambers are used, ideally the internal diameter of successive expansion chambers from proximal chamber to distal chamber are chosen so as to form a harmonic progression.

In one particularly suitable embodiment, there are three expansion chambers and the internal diameter of the intermediate expansion chamber is double that of the distal expansion chamber and the internal diameter of the proximal expansion chamber is the sum of the internal diameters of the other two expansion chambers.

Further, it is envisaged that the expansion chambers may comprise shockwave generators. This greatly enhances the operation of the expansion chambers.

In another embodiment of the invention, the outer portion of each expansion chamber is connected to a bleed-off vent pipe which in turn feeds the cyclone chamber downstream of the expansion chambers.

In another embodiment of the invention, gas draw-off pipes are provided for the removal of gases given off by the fluid as it progresses through the cyclone chamber and the fan housing.

In a still further embodiment, a coil is mounted in the cyclone chamber for the collection of electricity induced by electrical charged metals entrained in the fluid causing a magnetohydrodynamic effect (MHD).

In a still further embodiment of the invention, portion of the cyclone chamber is adapted to form a plasma chamber.

Further, the invention provides a method of using the apparatus comprising drawing hydrogen gas off from the fluid as it progresses through the cyclone chamber and housing.

Further, the method comprises arranging magnets having their negative poles directed into the interior of the fan housing for extraction of the hydrogen.

In one embodiment of the invention, when the vortex flow forming means comprises a vortex flow forming device substantially centrally mounted within the vortex flow forming section, the vortex flow forming device further comprising an anode and the portion of the cyclone chamber forming the vortex flow forming section comprising a cathode and a DC power source connected between the anode and the cathode. The method includes first treating water to cause the water to form a negatively charged alkaline solution and dosing the acid waste with the treated water as the acidic waste is delivered through the apparatus.

In another embodiment of the invention, when a plasma chamber is used, it is envisaged that the method may include generating hydrodynamic shockwaves in the plasma chamber.

Detailed Description of the Invention

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a diagrammatic sectional view of portion of an apparatus according to the invention,

Figs. 2(a) and (b) are details of portions of the apparatus of Fig. 1,

Fig. 3 is a further detail of Fig. 1,

Fig. 4 is a view similar to Fig. 1 of an alternative construction of apparatus according to the invention,

Fig. 5 is an enlarged view of portion of the apparatus of Fig. 5,

Fig. 6 is a view of portion of another apparatus according to the invention,

Figs. 7(a) to (c) are front views of ring magnets used in accordance with the invention,

Fig. 8 is a still further view of another dewatering apparatus according to the invention,

Fig. 9 is a perspective part diagrammatic view of portion of an alternative construction of part of a cyclone chamber according to the invention,

Fig. 10 is a sectional diagrammatic view of the portion of the alternative construction illustrated in Fig. 9,

Fig. 11 is a view of portion of a vortex flow forming section according to the invention,

Fig. 12 is a sectional diagrammatic view of portion of an alternative construction of apparatus,

Fig. 13 is a sectional diagrammatic view of portion of an alternative construction of apparatus, and

Fig. 14 is a diagrammatic view of another vortex flow forming device according to the invention.

Referring to the drawings and initially to Fig. 1, there is provided a drying apparatus, indicated generally by the reference numeral 1, which comprises a cyclone chamber 2 having a centrifugal fan 3 located within a casing or housing 4. The centrifugal fan

3 is a substantially conventional impeller suction fan having blades 5 for creating a cyclonic air stream within the cyclone chamber 2 and is somewhat similar to the fan already described in the previously referenced PCT Published Specification WO 98/35756 (Next Century Technologies Limited). The fan, as previously described in this specification, has been provided with a casing or housing 4 which reduces in cross-section towards the exhaust end. A toroidal or flat scroll unit surrounds the impeller. Additionally, the blades 5 of the impeller have a perforated liner with transversely arranged ridges to form cavitation forming recesses. The fan 3 is generally one which imparts centrifugal flow but may impart centripetal flow.

The cyclone chamber 2 is divided up into a number of sections, not always physically different, such as one would expect from examination of Fig. 1, but into sections having different functions, namely, a vortex flow forming section 6 and a vortex flow shedding section 7. These are shown most clearly below the drawing with the use of subscript letters for clarity. In some cases, as can be seen from Fig. 1, the sections are quite physically distinct and, in other cases, they are not. However, in each case, one or more vortex flow forming sections 6 is/are followed by a vortex flow shedding section 7. Additional letters are used to distinguish one section from another. For example, the casing or housing 4 of the fan, as is normal, provides a vortex flow shedding section, although it is not identified as such. Further, again, when a vortex flow has been formed, the section in which the vortex flow is travelling, after having been formed, has, strictly speaking, a vortex flow shedding function in that the vortex flow tends to be dissipated along it, particularly if the vortex flow is carrying out work and disruption of the material. However, for convenience, it is easier to describe them as distinct sections. Finally, one can envisage constrictions of cyclone chamber with less designed or active, as it were, vortex flow forming sections.

The cyclone chamber 2 comprises at its downstream or proximal end, a frusto-conical air inlet 8 having vortex flow forming vanes 9 on the interior surface thereof and is thus a vortex flow forming section 6(a). The frusto-conical air inlet 8 feeds a cylindrical portion 10 into which projects, at 11, a material infeed hopper 12. The cylindrical portion 10 forms a vortex flow shedding section 7(a) and a vortex flow forming section 6(b). The vortex flow shedding section 7(b) mounts vortex flow shedding means, namely, a plurality of vortex flow shedding devices, indicated

generally by the reference numeral 13. The vortex flow shedding devices 13 comprise a plurality of bars 14 projecting some way into the vortex flow shedding section 7(a). The bars 14 project into the vortex flow shedding section 7(a) so as to project at various inclinations to the interior downstream and upstream of a further vortex flow shedding device 13 formed by a sphere 15 mounted centrally within the vortex flow shedding section 7(a) by radially arranged support arms 16 which will also have a vortex flow shedding function. The vortex flow shedding section 7(a) feeds into a vortex flow forming section 6(b) having vortex flow forming means provided by a vortex flow forming device, indicated generally by the reference numeral 17. In this embodiment, the vortex flow forming device 17 comprises an egg-shaped device, hereinafter, for simplicity, an egg 18, illustrated in more detail in Fig. 2(a). The egg 18 has an upstream portion 19 which is broader than its downstream portion 20. Vanes 21, for assisting in establishing vortex flow, are mounted on the exterior surface of the egg 18. The use of vanes is optional. The egg 18 is mounted by radially arranged bars 22 within the vortex flow forming section 6(b). This vortex flow forming section 6(b) then discharges via a reducing cross sectional portion 23 of the cylindrical portion 10 into a vortex flow shedding section 7(b) of initially a suddenly increased and then a gradually reducing cross sectional area, namely, a frusto-conical shaped section 24 of the cyclone chamber 2, which then communicates with another vortex flow forming section 6(c). Mounted in this vortex flow forming section 6(c) is a further vortex flow forming device, again indicated generally by the reference numeral 17, in this embodiment formed by a further egg 25, namely, an ovaloid shaped body, illustrated in more detail in Fig. 2(b). The egg (25) is again mounted by rods (22) in the section (24) of the cyclone chamber (2).

Referring specifically to Fig. 2(b), it will be noted that the egg (25) has further vortex flow forming and directing vanes 27 and additionally this egg 25 is symmetrical about its vertical axis such that its downstream end or proximal end 28 is of the same shape as its upstream or distal end 29. Referring again to Fig. 1, then the frusto-conical portion 24 discharges into another cylindrical portion 30. This cylindrical portion 30 again forms part of a vortex flow forming section 6(d). It will be appreciated that there will be a certain amount of flow shedding or dissipation taking place now within the cylindrical portion 30, however, since there are no specific vortex shedding devices mounted in the cylindrical portion 30 nor does the latter's shape promote vortex

shedding, it is more properly described as vortex maintaining, if not forming. To use the term "maintaining" would cause more confusion.

Then, adjacent an upstream exit 32 of the cylindrical section 30, which again is of reducing cross section, there is mounted a further egg 25 forming a vortex flow forming device 17. This egg 25 again concentrates the vortex flow that may have been slightly dissipated in the vortex flow forming section 6(d) so that a tight vortex is then delivered into the next part of the cyclone chamber 2, namely, a frusto-conical portion 33 which initially forms another vortex flow shedding section 7(c) leading into a vortex flow forming section 6(e). This portion of the frusto-conical portion 33 houses a further vortex flow forming device 17, provided by an egg 18. The vortex flow forming section 6(e) continues on into a further cylindrical portion 34 which again has a discharge outlet 35 of reducing cross-section leading into a further vortex flow shedding section 7(d). Mounted in the discharge outlet 35 of the vortex forming section 6(e) is a further egg 25. This vortex flow shedding section 7(d) is formed in another portion of the chamber 2 and comprises initially an expanding portion 37 which in turn leads into a portion 38 of decreasing cross-sectional area.

A main water drain-off pipe 40 is fed by a plurality of further drain-off pipes 41, each incorporating non-return valves 43. The pipe 40 feeds a sump 42. The drain-off pipes 41 are connected at various places to the cyclone chamber 2. A material return pipe 45 connects an outlet hopper 46 for the fan 3 to the material infeed hopper 12 for recirculation of material. There is provided a source of ozone, namely, an ozone generator 95 feeding, through a control valve 96, the cyclone chamber 2.

Referring now specifically to Fig. 3, there is illustrated ionisation means, namely, a plasma generator, indicated generally by the reference numeral 47, having a plasma chamber, in this embodiment provided by a hollow torroidal unit 48 encased in an electromagnetic coil 49. Only the torroidal tubes 48 are illustrated in Fig. 1.

In use, the electromagnetic coil 49 is adapted to produce coherent electromagnet waves such as hydrodynamic shockwaves that are capable of giving rise to compression and rarefacation of particles and also capable of producing massive ionisation and subsequent desolvation, vaporisation, disassociation and excitation of

the fluid flowing in the torroidal unit 48 Each torroidal unit 48 is defined by rotating a circle and is thus much the same shape as the fried cake called the doughnut or donut. The torroidal unit 48 is of a non-ferrous material, preferably one that is self-exciting such as barium titanate.

In operation, wet material such as, for example, wet sewage is introduced into the inlet hopper 12 from which it is delivered at 11 into the vortex flow shedding station 7(a) where it is impinged upon by air drawn through the inlet 8 which has been imparted with vortex flow by the vanes in the vortex forming section 6(a). Then this vortex flow is destroyed in the vortex flow shedding section 7(a) by the vortex flow shedding devices, namely, the bars 14 and the sphere 15. Any vortex flow that has not been dissipated will then be mostly dissipated by the time the flow hits the egg 18 at its downstream end 19. Then the egg 18 and vanes 21 will cause vortex flow to be reformed and a tight centripetal vortex will be formed adjacent the downstream portion 20 of the egg 18.. This vortex flow in the vortex flow forming section 6(b) then delivers out into the vortex flow shedding section 7(b) which is provided by the frusto-conical portion 24 of the cyclone chamber 2. This frusto-conical portion 24 forms an expansion chamber such that a vacuum will be formed behind the vortex flow being delivered into the vortex flow shedding section 7(b). Then, the material and air is delivered down through various vortex flow forming and vortex flow shedding stations to the fan 3.

It will be appreciated that, for example, the two eggs 18 and 25 are interchangeable and that similarly, whether they mount respectively vanes 21 and 27, is optional.

Ideally, the vortex flow shedding bars 14 can be provided by vertically scored threaded bolts because their roughened surface is ideal for vortex shedding. The bars 14 also act as a safety device preventing, for example, a person's hand being dragged into the cyclone chamber.

Referring to Figs. 4 and 5, there is illustrated an alternative construction of de-watering apparatus, again indicated generally by the reference numeral 1, in which parts similar to those described with reference to the previous drawings, are identified by the same reference numerals. In this embodiment, the sphere 15 and

eggs 25 are mounted between three equi-spaced struts 51 and a central bar 52 which projects through the cyclone chamber 2. The feed hopper 12 is now positioned in a frusto-conical portion 53 and projects two thirds of the way along the sphere in the downstream direction. The frusto-conical portion 53 connects with a cylindrical portion 54. Then, there is provided what is effectively an expansion chamber by a further portion of the cyclone chamber 2 comprising an increasing frusto-conical section 55, a cylindrical section 56 and a decreasing frusto-conical section 57 in the direction of the air flow. This portion then connects with a further cylindrical portion 54 which in turn feeds into a further expanding portion 37. It will be appreciated that the whole apparatus can consist of the one elongate cylindrical chamber with various vortex flow forming and shedding sections. In this embodiment, the bars 52 form anodes and the various cylindrical portions 54, the frusto-conical sections 55, cylindrical section 56 and frusto-conical section 57 all comprise a cathode 60 covered by a ceramic insulator 61. This provides a novel apparatus for electrochemical activation. A portion of the construction of the cylindrical section 54 is illustrated in Fig. 6. A DC power source 60 is illustrated connected to the bars 52 and to the cylindrical portion 54. A controller 61 is connected to the DC power source 60. Gas draw-off pipes 65 and one-way valves 66 are provided and connected to the cyclone chamber 2 along its length.

In use, if the anode is at the centre, it effectively creates a bleach, chlorodioxide, hydrogen peroxide, and so on, which gives off free hydrogen. If, conversely, the inner bar forms a cathode, we get a hydroxide and free oxygen is given off. Where we accompany these anodes and cathodes with like or opposing magnetic fields we further weaken the bond for hydrogen as water has two bonds - electrical and magnetic. This process lends itself to desalination in a pipe where flow is generated by a venturi, pump, or suction and the chlorine is separated from the sodium.

The ions generated by the presence of the cathode or anode respectively are important. In the first instance, free hydrogen is given off (this is known but not the method whereby the hydrogen electrons can be stripped off so it is suggested that this apparatus also serves as a response to the need for such a device for transportation etc. as the force of the travelling in-winding vortex will, it is suggested, carry off the electrons). The result is a very acidic condition particularly

in the presence of salt water or water to which salt is added. It has been known that it is possible to achieve 0:025 pH in solutions containing one or more of ClO_2, Cl and H_2O_2, etc.. Adding salt to particularly hazardous waste will provide a bleaching effect with the anode in the centre.

Conversely, reversing the poles will produce copious amounts of various forms of sodium hydroxyls up to pH 12. This increase in concentration will not only serve to desalinate water but to increase the apparent metal content for magneto hydrodynamic (MHD) operation to produce electricity. This device on an industrial scale would solve the need to produce copious amounts of extreme pH as required - for example the acid rich tailing waters from a mining operation which destroys agriculture and the alkalinity will bind the heavy metals. It is proposed that this apparatus will solve many wastewater problems and make new chemical processes possible. The state of the art is known and well developed for instance, in Russia, however the state-of-the-art requires that the process be contained in a series of small metal tubes and the unit is expensive for the small amounts of power produced.

Finally the ceramic sleeve can be removed and a situation whereby plasma can be produced using electrodes similar to those used recently in laboratory experiments on disassociation and heat generation at up to 200% efficiency protruding together from the egg will again produce a system whereby such a phenomena can be industrialised. In this instance a new process for generating heat can be obtained by adding potash to the feedstock whereby hydrogen and subsequent heat would be produced at their recombination in the plasma. Again this process can industrialize such a phenomena. The advantage in drying or dewatering would be evident.

Referring now to Fig. 6, there is illustrated an egg 25, as previously described, used to produce an in-winding centripetal vortex in a frusto-conical section of the cyclone chamber, again identified by the reference numeral 24. The egg 25 comprises a magnet. For example, it is envisaged that in treating various acidic or caustic waste, it is advantageous to first treat water separately to make it essentially alkaline and then dose it or introduce it into the waste product when treating the waste product. In this way, the waste product is partially neutralised

before it is introduced into the apparatus 1. The egg 25 may have a magnetic centre of various shapes and orientation preferably supporting the anode or cathode respectively is surrounded by a spiralling anode or cathode and a ceramic or other suitable material also spirally wound and possibly accompanied with a magnet and shaped in a sloping manner to conform to the reduced area of flow generated by the egg to shield the electrolyte but not the ions generated by the presence of the cathode or anode respectively is provided. In the first instance, free hydrogen is given off, thereby destabilising the water bond and facilitating subsequent disassociation and evaporation.

It will be appreciated that the eggs, as indeed all of the other vortex flow forming devices, may comprise magnets.

Referring to Figs. 7(a) to (c), there is illustrated various ring magnets 70, 71, and 72, formed from a plurality of triangular magnets 73. It will be noted that the ring magnet illustrated in Fig. 7(a) comprises triangular magnets 73 of alternative polarity, while the ring magnet 71 of Fig. 7(b) illustrated a ring magnet with its positive pole inwardly directed into the cyclone chamber 2 and finally, the ring magnet 72 has its negative pole directed inwardly into the cyclone chamber 2.

It is possible to have a series of these ring magnets alternating themselves in position to create chaos , thus destabilising the ions prior to chemical activation for a more efficient processing. The purpose is that the in-winding vortex is fully treated by the magnetic orientation and the ring magnet placed around the field assists in this.

Referring to Fig. 8, there is illustrated an alternative construction of apparatus, again indicated generally by the reference numeral 1. The apparatus 1 in Fig. 8 is only shown in outline and parts similar to those described with reference to the previous drawings are identified by the same reference numerals. In this embodiment, there is provided a plasma generator, again indicated generally by the reference numeral 47. In this embodiment, the plasma chamber comprises an enclosed spirally wound tube 75 adjacent the cyclone chamber 2 with a straight return pipe 76 remote from the cyclone chamber 2.

Referring now to Figs. 9 and 10, there is illustrated an alternative construction of vortex flow shedding section, again indicated generally by the reference numeral 7. In this embodiment, the vortex flow shedding section 7 comprises three expansion chambers, namely, a proximal expansion chamber 80, an intermediate expansion chamber 81 and a distal expansion chamber 82, in the direction of the travel of flow, as illustrated by the arrow. It will be noted that these are of greater cross sectional area than the vortex forming section 6 upstream of it and that the proximal expansion chamber 80 to the vortex flow forming section 6 is of greater cross sectional area than that of both the intermediate expansion chamber 81 and the distal expansion chamber 82. Each expansion chamber 80, 81 and 82 is connected to a vent pipe 83 which in turn is connected, at 84, to a duct 85, downstream of the distal expansion chamber 82. In operation, it will be appreciated that a vacuum will be formed in the pipes 83 by virtue of the vortex shedding and an additional vacuum will be formed at 84 by the venturi effect exerted on the pipe 83 by the flowing fluid in the duct 85, thus drawing fluid into the duct 85. Optional shockwave devices or generators 86 are mounted on the interior of each expansion chamber 80, 81, and 82. Each generator could, for example, be a transducer, a solenoid or various other oscillator devices and the like which would enhance the process.

Ideally, the internal diameter of the expansion chambers is chosen to form a harmonic progression between the expansion chambers. For example, the internal diameter of the intermediate expansion chamber 80 can be made to be double that of the distal expansion chamber 82 and the internal diameter of the proximal expansion chamber 80 can be configured to be the sum of the internal diameters of the other two expansion chambers. In this way, it is suggested that resonant cavities will be set up. The phenomenon so far observed appears to indicate that each sets up a powerful ring-like zone of pulsed cavitation and a zone resonation of some specific frequency and power. It has been found that when the relative internal diameters are correctly chosen, there is little, if any, discords to continuous action. The shockwave generator 86 appears to accentuate the operation of the expansion chambers. Further, it will be appreciated that the ionisation means may also be provided.

It is envisaged that any flow accelerating means may be combined with the expansion chambers. Indeed, it is envisaged that a seismic transducer which converts such imparted acceleration into a proportional electrical signal may be used. Thus, the incorporation of magnets and similar devices in conjunction with the expansion chambers is envisaged.

Referring now to Fig. 11, there is illustrated an alternative construction of apparatus, again indicated generally by the reference numeral 1, in which parts similar to those described with reference to the previous drawings, are identified by the same reference numerals. In this embodiment, there is illustrated coils 90 mounted in the cyclone chamber 2 connected by wires 91 to an electrical assembly 93.

In operation, the coils 90 and the electrical assembly 93 will form a magnetohydrodynamic (MHD) assembly. Essentially, the fluid flowing, together with any metals contained therein, will form a conducting fluid and the coil will form a magnetic field such that the generation of electricity is possible. This provides a method of electrical power generation without moving mechanical parts. The actual mathematics and theory of MHD is beyond the scope of this specification. Further, it is known that by applying fluid velocity and current density, rather than the velocity and magnetic field as the primary variable, it is possible also to generate electricity.

Referring now to Fig. 12, there is illustrated an alternative construction of vortex forming section, again indicated generally by the reference numeral 6, mounted within a duct 94 of constant cross section, carrying a pair of eggs 25, again in the form of an ovaloid shaped body, mounted between a ring magnet, again identified by the reference numeral 71. The two eggs comprise magnets and it will be noted that the two eggs 25 face each other with the same polarities, namely, negative polarity. Equally well, it could be positive polarities facing each other or more likely, opposite polarities. Thus, for example, both eggs would be mounted so that the upstream end was a positive polarity and the downstream end, of negative polarity. It is also envisaged that the eggs may be formed of a body of reducing cross

section from its upstream end to its downstream end.

Referring to Fig. 13, there is illustrated an alternative construction of vortex flow forming section, again indicated generally by the reference numeral 6, comprising a duct 100 mounting a vortex flow forming device, again identified by the reference numeral 17, which comprises an egg shaped body, hereinafter simply "an egg 101", mounted by means of hollow struts 2 forming electrical cable receiving conduits. The egg 101 further comprises an electrical generator assembly, indicated generally by the reference numeral 103, which in turn comprises a wind turbine 104 connected to an electrical generator 105. The wind turbine 104 essentially comprises a rotatably mounted tip or rear portion 106 of the egg 101 which is rotatably mounted thereon and has wind turbine blades 107 for rotation of the tip 106 which is connected to a rotor 111 of the electrical generator 105. The electrical generator 105 is of conventional construction having a flywheel 108 and conventional permanent magnets 109 and coil 110. The rotor 111 can ideally be mounted by means of magnetic bearings, as can the tip 106. In operation, when the tip 106 is in a centripetal vortex, it will be subjected to this high speed in-winding vortex which will rotate the generator 105 at a high speed and electrical power can be taken off through the hollow struts 102.

It will be appreciated that the generator and associated turbine can be of any known construction. For example, in Fig. 14, there is illustrated a further vortex flow forming device 17, again comprising an egg 120 mounting a generator, again identified by the reference numeral 105. This egg 120 is essentially of similar construction to the egg 101, except that there is now mounted, on its downstream end, exposed propeller blades 121, again connected to the rotor 111, which blades 121 form a wind turbine.

It is further envisaged that the construction may be combined with any of the previous constructions of vortex flow forming device. It is also envisaged that this particular embodiment of the invention may be used to supply both controlled flow and power to electrochemical devices to ionise and alter the pH of the feedstock.

It is envisaged that instead of having the vortex flow forming device forming one of

an anode or a cathode, the vortex flow forming device could be arranged so as to form both an anode and a cathode.

Various tests have been carried out on the apparatus according to the invention and, for example, on an apparatus manufactured substantially as illustrated in Fig. 1 in which the plant comprised a fan having 25 cfm (cubic feet per minute) output and a cyclone chamber length of approximately 35 feet with a diameter of 8 inches, the following results were achieved.

Test No. 1

Product In:	Liquid farmyard manure pig slurry
% dissolved solids:	1.82%
% solids output product:	87.75%
Air Out:	Odourless
Product Out:	Odourless

Test No. 2

Product In:	Peat and Water (10:80)
% dissolved solids:	9.2%
% solids output product:	95%
Air Out:	Odourless
Product Out:	Odourless

While these tests are very impressive, it is envisaged that improved results will be

obtained, however, all these tests have not been carried out. Thus, it will be appreciated by those skilled in the art that various minor modifications of the apparatus and the matter of operating it may be determined on further use of the apparatus.

In the specification the terms "comprise, comprises, comprised and comprising" or any variation thereof and the terms "include, includes, included and including" or any variation thereof are considered to be totally interchangeable and they should all be afforded the widest possible interpretation and vice versa.

The invention is not limited to the embodiment hereinbefore described, but may be varied in both construction and detail within the scope of the claims.